

REMARKS

As the above claim clearly identifies, the core present invention is embodied in the unique use of a control system to manipulate the torque requirement that the generator applies to the prime mover. The prime mover and generator are both prior art components, and the description of the response of the prime mover to changing torque loading is a limitation of *which* prior art prime movers the present invention is applicable to. In particular, this invention is only applicable to those prime movers which change speed (accelerate or decelerate) in response to a change in applied torque. The present invention is not applicable to prime movers which do not change speed.

The use of prime movers which change speed in response to changing torque load is clearly described throughout the specification, both in the general case and in the specific examples. A graphical description of this is provided in figure 5, description starting on page 12, at line 35.

The internal combustion engine has a torque versus speed curve shown in Figure 5 which shows operation over a wide speed range. Prime movers and engines which operate at different speeds are well known in the art, and are the most common sort of prime mover.

In the specification, the generator is clearly described as being mechanically locked to the prime mover. Please see the various example embodiments and the description on page 15 lines 1 to 14. The prime mover is described as being coupled to the generator with a shaft, or with a fixed ratio gear system. No slipping component or variable ratio gear components are described, and the prime mover and the generator are always synchronized in a fixed (generally 1:1) speed relation. There is no slipping or variable synchronization as would be provided by a clutch, torque converter, or output turbine, but rather the generator and prime mover always operate at the same relative speed.

As per discussion with the examiner, the wording 'toward a synchronous' speed is changed to 'toward an equilibrium' speed to more clearly point out and define that the engine and generator are always synchronized, but that the mechanical output of the system is adjusted by adjusting the mutual speed of the engine and generator. This change is achieved by changing the

Proprietary and Confidential, Property of Borealis Technical Limited
Title: ELECTRONICALLY CONTROLLED GENERATOR SET, Filed September 28, 2000
Amendment, Filed: July 25, 2003
Page 15 of 19
Jonathan Edelson

equilibrium speed, changing the generator mechanical input requirements so as to change the mechanical output of the prime mover. Many different prime movers are known in the art, and the claim limits to those prime movers which will be controlled by the method of the present invention, to wit those prime movers which comprise a characteristic of acceleration and deceleration in response to the torque load on the prime mover. Prime movers may exist which operate at fixed speeds, or whose consumption of potential energy does not change as their speed changes, thus making them unsuitable for the present invention.

Examples of prime movers whose fuel consumption and power output change with mechanical output speed are provided throughout the specification, and in particular are listed on page 14 starting at line 27.

The present invention overcomes prior art through the exclusive use of controlled mechanical loading on the prime mover to adjust the mechanical output of the prime mover. Prior art control systems used throttles or adjustable fuel injection pumps, or otherwise directly control the fuel consumption of the prime mover. The closest known prior art recognizes the loading effect of electrical machines on prime movers, and adjusts this loading to adjust for other mechanical fluctuations, but does not use the loading effect of electrical machines, or variable mechanical loads in general, as the primary control means for the prime mover systems.

A description of this control heuristic is provided several times in the specification, in several different ways. The most general description starts on page 18, line 32, where I describe clearly how the torque of the generator should be changed in order to control the speed of the prime mover. I then go on to describe how this same control technique may be understood in terms of mechanical shaft power and electrical power. Additionally, each of the particular examples provides description of apparatus which implement this control technique. For example on page 20 starting at line 9, the use of a changing resistive load to adjust heat engine power output is described, wherein the heat engine is slowed down and the power output is reduced by reducing the connected resistance.

Of particular importance in determining the novelty of the present invention, the examiner is requested to note that the control paradigm presented, as well as the particular implementation

Proprietary and Confidential, Property of Borealis Technical Limited
Title: ELECTRONICALLY CONTROLLED GENERATOR SET, Filed September 28, 2000
Amendment, Filed: July 25, 2003
Page 16 of 19
Jonathan Edelson

examples, are counter intuitive when considered in the context of prior art and conventional control techniques. As described in many different ways in the specification, in a situation which calls for *increased* power output from the heat engine/generator system, an action is taken which *reduces* the torque input to the generator. This means that the mechanical power input to the generator, and thus the electrical power output of the generator will be *reduced*. However by *temporarily* reducing the electrical power output, the prime mover is allowed to accelerate, and the eventual result is that the power output of the system is increased.

Similarly, when the power output is to be reduced, the first step is to *increase* the mechanical power consumption of the generator, causing the prime mover to slow down and eventually reach the desired power output.

These temporary changes in power output, in the opposite direction of the desired eventual result, are clearly described. The use of accessory energy storage in order to provide continuous supply to the eventual load, or to even power the generator as a motor, is also described.

In the particular example of a heat engine coupled to a DC generator with a resistive load, reducing the load resistance is shown to *reduce* power output. This occurs because the generator torque is increased and the engine/generator system speed must reduce until the engine and generator torques are back in balance. In conventional prime mover/generator system, an increase in load is often accompanied by a reduction in prime mover rotational velocity. However it is also understood that at the moment the lower resistance is applied, power output actually *increases*. It is only because the present system uses this momentary increase in power output to reduce the speed of the prime mover that the equilibrium power output is reduced.

In a conventional system in which the engine speed is being regulated via a throttle, the increase in power flow through the resistance would be permanent, as the prime mover would not slow down. Thus in a conventional system, in order to reduce power output, the resistance must be reduced.

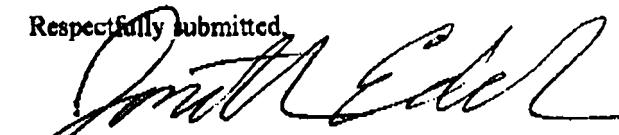
CONCLUSION

Applicant respectfully submits that this application, as amended, is in condition for allowance, and such disposition is earnestly solicited. If the Examiner believes that discussing

Proprietary and Confidential, Property of Borealis Technical Limited
Title: ELECTRONICALLY CONTROLLED GENERATOR SET, Filed September 28, 2000
Amendment, Filed: July 25, 2003
Page 17 of 19
Jonathan Edelson

the application the Applicant over the telephone might advance prosecution, Applicant would welcome the opportunity to do so.

Respectfully submitted,



Jonathan Edelson
Inventor

FAX RECEIVED

JUL 24 2003

TECHNOLOGY CENTER 2800

Proprietary and Confidential, Property of Borealis Technical Limited
Title: ELECTRONICALLY CONTROLLED GENERATOR SET, Filed September 28, 2000
Amendment, Filed: July 25, 2003
Page 18 of 19
Jonathan Edelson

Version of Amended Claim 223 with markings to show changes made**223. A prime mover output control system, comprising**

- a) a prime mover, comprising a mechanical output comprising a rotational velocity and a torque; and
- b) a generator, powered by said prime mover, and providing an adjustable torque load on said prime mover,
wherein said prime mover comprises a characteristic of acceleration and deceleration according in response to said torque load on said prime mover, towards a synchronous mean equilibrium speed with said generator; and
- c) a control mechanism electrically connected to said generator, comprising an input for signaling a system power output requirement, said control mechanism providing control over said adjustable torque load of said generator, said adjustable torque load being reduced when said rotational velocity of said prime mover is not sufficient to produce said power output requirement, said adjustable torque load being increased when said rotational velocity of said prime mover is in excess for the production of said power output requirement, to effect a product of prime mover rotational velocity and torque to substantially meet said system power output requirement.